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APPLICATION OF SPECIFIC PREDICTION METHODS IN THE PROCESS OF CRIMINOLOGICAL FORECASTING

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Research article

Abstract: The mission of criminology is not only to describe, explain and interpret the existing ones, but it must also anticipate a closer and more distant future. The value of criminological knowledge is determined by its accuracy and completeness, as well as the timeliness, which provides the prerequisites for making decisions without time constraints. The development of reliable forecasts of crime, usable for making the highest decisions and effective practical measures, requires not only correct and comprehensive analysis of the prognostic background that causes its development, but also the most effective use of current methodological instrumentation of forecasting.

Keywords: Security, Crime, Predicting, Specific Methods, Criminological Forecasting.

Introduction

Violation of certain social and legal norms, rules, is the main essence of crime (Lubelcova, 2009). People who are unable to integrate into society are often a source of crime, which affects the security of the area. Therefore, measures must be taken to suppress these negative activities, to make the level of crime effective and to increase the security of people in a given area (Heidensohn, 1993). Violation of certain social and legal norms, rules, is the main essence of crime (Kumar, 2018). People who are unable to integrate into society are often a source of crime, which affects the security of the area. Therefore, measures must be taken to suppress these negative activities, to make the level of crime effective and to increase the security of people in each area.

In this regard, it is important to know what the level of crime is and how the level of crime may change in the future (Gaspierik, 2003). Within this issue, methods of predicting the future are used, with the help of which we can predict the future development of the crime level of a certain area and thus effectively design and implement measures to increase the level of security (Hofreiter and Byrtusova, 2016).

Theoretical framework

Prediction can be described as a scientific prediction of a hitherto unknown, unobserved but possible state of society, processes and phenomena (Hofreiter, 2016).

When it comes to security situations, the prediction of these conditions does not represent their guess but relies on proven scientific methods and procedures, which can be used to create variants of future possible conditions (Hofreiter, 2016).

We can examine scientific prediction on two levels:

a) *empirical prediction* - based on the observed repeatability of phenomena, using the experience and repeatability of observed relationships, dependencies and contexts. In particular, temporal sequence or periodic repeatability is used;
b) *theoretical prediction* - used of mathematical and statistical procedures, models (Hofreiter, 2016).

Prediction of the future depends on the objective, conditional and dynamic factors, but also on subjective factors that affect the security situation of the security environment and thus create the character of:

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a) *objective uncertainties* - the ambiguity of development over time,
b) *subjective uncertainties* - the active influence of the subject on the course of processes in the security environment (Hofreiter, 2016).

Future prediction methods

The concept of the prediction method represents a set of theoretical and practical rules that lead to the creation of a forecast of future states of the security situation in a secure environment with a certain explanatory power (Hofreiter, 2016).

Their basic division is shown in Fig. 1.

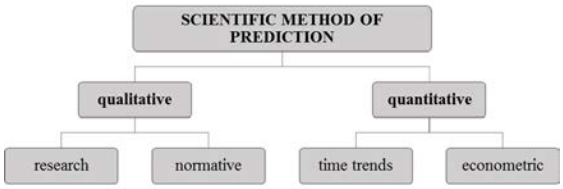

Fig. 1 Scientific methods of prediction (Hofreiter, 2016)

Qualitative prediction methods

These methods can be applied in cases where relevant available data are not available or the phenomena cannot be described by specific quantified data. In this case, it is the statements of experts who predict the future based on their previous experience, considerations and subjective intuitions (Hofreiter, 2016).

Qualitative prediction methods can be divided into research and normative methods.

a) *Research methods:*
- are based on information about the past and the present,
- apply heuristic approaches towards the future,
- make it possible to obtain a prediction of what the next development will be, what events or phenomena may occur in the future,
- predict the future, that is, "what will be" we predict based on what was, what happened in the past and what we did, or what happened in the present (Hofreiter, 2016).

Research quantitative methods most often include projection methods. These methods are relatively simple, as they predict the persistence of past developments in the future without allowing for possible changes in conditions that may occur in the future (Hofreiter, 2016). The most used projection methods are shown in Fig. 2.

PROJECTION METHODS	
Analogy	Consistency of characters and properties of non-identical phenomena
Historical analogy	Using historical knowledge to find matching characters
Extrapolation	The future as a continuation of current developments
Delphi method	Repeated, anonymous inquiries from experts (comparison of opinions)
Prediction	Expert opinions on the future, regardless of the present
Wild card	Assumption of unlikely but dramatic events

Fig. 2 Qualitativeive methods - projection methods (Hofreiter, 2016)

b) *Normative methods:*
- creating a vision of the future world based on "what should happen",
- there is an active entry of the subject into the management of the development of events and processes in the environment, which aims to achieve the target, desired state (security, crime levels, etc.) (Hofreiter, 2016).

The normative method most often includes the *scenario method*.

The scenario is a sketch with a breakdown of the story, which offers possible solutions to a certain situation. It is an attempt to describe almost in detail a certain expected sequence of events.

The scenarios aim to try to describe possible future developments based on knowledge of the developmental relationships between specific events, processes and factors. By analyzing known, identified factors and uncertainties and combining them to create variants of future development, we can divide the scenarios into three groups, which are shown in Fig. 3 (Hofreiter, 2016).

TYPE OF SCENARIOS	
Normative predictive (what should happen)	Creating an idea of the future with the application of active interventions of the subject
Non-normative predictive (what will be)	Creating an idea of the future without the management intervention of the subject
Postdictive (what would it be if)	Analysis of the causes of the negative development at present (retrospective hypotheses)

Fig. 3 Qualitative scenario methods (Hofreiter, 2016)

Quantitative prediction methods

The basis of these methods is primarily the use of statistical data, which are created, processed and evaluated using statistical methods and mathematical models. Quantitative prediction methods can be divided into time trends tracking methods and econometric methods (Hofreiter, 2016).

a) *Time trends:*
   - are based on a chronological series of individual variables,
   - assumption of future development based on the analysis of the movement and dynamics of the development of previous variables (Hofreiter, 2016).

b) *Econometrics methods:*
   - the mathematical expression of the relationship between independent variables and the evolution of the values of a dependent variable (Hofreiter, 2016).

The basic and most applied quantitative method of predicting the future is extrapolation. This method represents a generalization of the development from the past to the future, assuming the preservation of the same conditions and the same result in the action of internal and external causes of events (Hofreiter, 2016).

The resulting extrapolation values are expressed in the form of a line (ascending, descending) or a curve (cyclic, logistic, exponential) in Fig. 4.

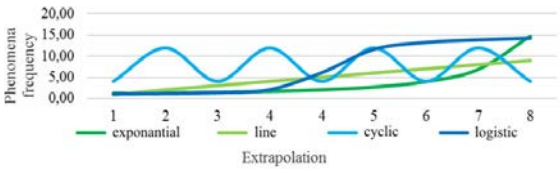

Fig. 4 Forms of the resulting extrapolation values

Criminological forecasting

The stochastic nature of the crime, as well as its high degree of uncertainty about possible future developments, its complexity of structure or diversity of external and internal relationships, determine the requirements for the use of methodology, predicting methods and their integration and use in special methodologies (Holcr, 2008). As part of predicting the future state of crime, the level of crime, or the frequency of occurrence of individual crimes with an emphasis on the territorial division of a certain area, we can use many criminological prognostic methods (Sukhodolov et al., 2019).

Extrapolation and observation time trends

As we have statistical data in the form of the number of crimes for a certain period, opens up the possibilities for the application of quantitative methods of prediction - extrapolation with the monitoring of time series. However, we must assume that the same conditions will be maintained during the events as in the past. From the mathematical-statistical tools needed for this analysis, it is necessary to collect and statistically processed data and apply time trends methods to determine the corresponding course (Potucek, 2006).

As an example, we can mention the statistically processed number of burglaries in the Trencin Region in the period 2012-2020, which is shown in Tab. 1.

Tab. 1 The number of burglaries in the Trencin region in the period 2012-2020 (MINV, 2021)

Year								
2012	2013	2014	2015	2016	2017	2018	2019	2020
Number of burglaries								
1180	937	896	563	592	617	492	304	361

If we belong to the same statistical universe, using the method of extrapolation with time trends monitoring, we can assume that in 2021 the number of thefts by burglary within the Trencin region will be 321.

The use of extrapolation in the criminological predicting process can be significantly influenced or limited by various factors. For this reason, it is necessary to use other specific methods in parallel, which would compensate for the weaknesses of extrapolation, which would ultimately bring more realistic values in the future (Holcr, 2008).

Wheels of the future

The wheels of the future are a qualitative method of prediction that organizes thinking and raises questions about the future. It identifies and estimates the consequences of events and trends and is considered one of the components of the brainstorming method. The principle of the method is that the name of the underlying event or trend is placed in the middle of the document and other contexts are added to it, usually in points. The first circle is represented by the primary consequences, then the next circle by the secondary until all the impacts of the solved event or trend are clarified (Potucek, 2006). An example of the wheels of the future-focused on the level of crime is shown

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in Fig. 5. In this case, security measures have been placed as secondary consequences, which have a significant impact on the development of the level of crime in the future.

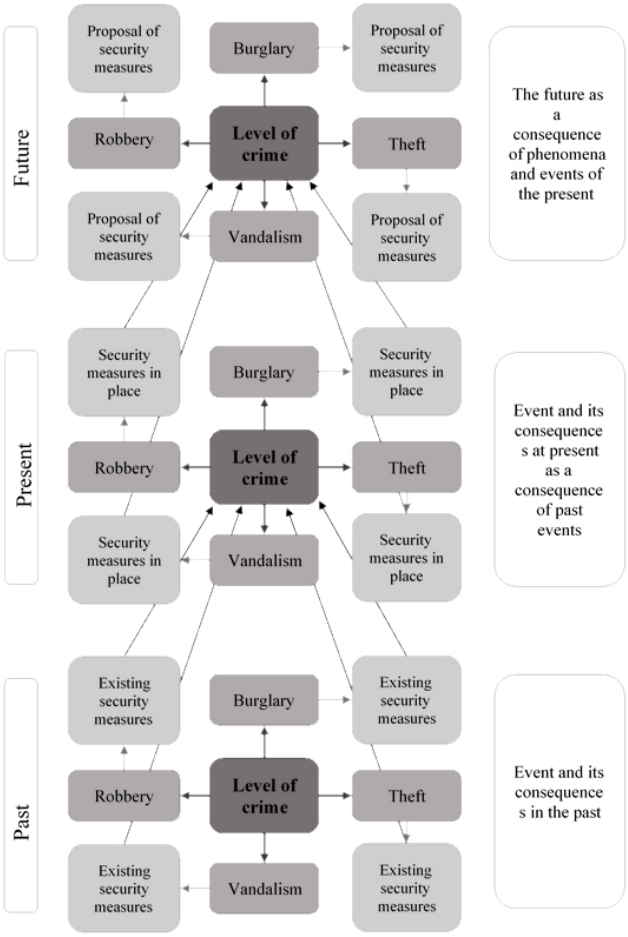

Fig. 5 The possibility of using the wheels of the future method to predict the level of crime

Future status index

If we focus on the security of a certain environment, the future status index can be a statistical combination of the values of key safety indicators, such as:

- presence of street gangs, vandalism, damage to public/private property, acts of violence in public, drug consumption and distribution and others.

It is a qualitative method of prediction based on the evaluation of experts who identify problems and trends that have a significant impact on increasing the level of crime (Potucek, 2006).

Expert panels

The main task is the synthesis of various types of input data and the creation of documentation that would provide vision, suggestions for increasing the level of security in the future (Gorr and Harries, 2003). The group of participants should be diverse, and it is important that, in addition to professional qualifications, experience and interest, these members have a creative mind and offer a different perspective on the issues addressed (Potucek, 2006). This qualitative method of prediction can be used in analyzing the level of crime and proposing new security measures to reduce it in the future.

Prediction scenarios

If we focus on crime, the scenario can be a statement - a story about the possible future state of crime.

The aim is to predict the level of crime in the future based on knowledge of developmental connections between relevant events, processes or factors that directly affect the level of crime (Tomášek, 2010).

When we focus on predicting the level of crime in a certain area, we can use three models of scenarios:

- non-normative predictive scenario - creating an idea of the future possible state of the crime level without the intervention of entities (police, municipality, private security services and others),
- normative predictive scenario - creating an idea of the future ideal state of the level of crime with the intervention of subjects (creating security measures, application of crime prevention proposals, etc.),
- postdictive scenario - we are talking about the retrospective hypothesis, where we try to know the causes of negative developments at present (e.g. identifying the causes of the current high level of crime in the region).

The incorporation of these methods into the research methodology requires a correct assessment of their strengths and weaknesses, as well as functions in the individual phases of criminological forecasting, which is shown in Fig. 6.

Such a procedure is commonly used in prognostic practice and has its most reciprocal justification.

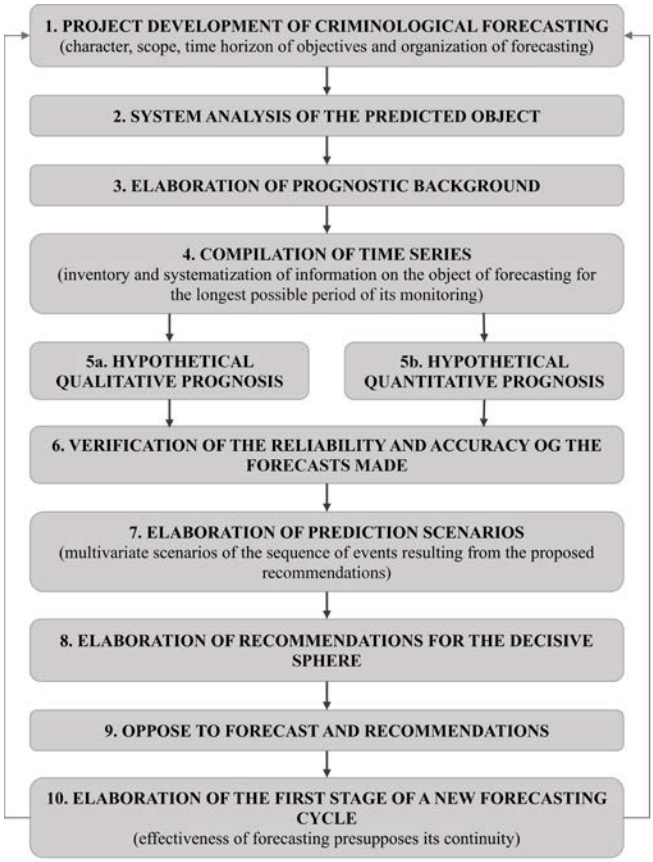

Fig. 6 Inclusion of specific prediction methods in the process of criminological forecasting

Discussion

As part of ongoing research at the Faculty of Security Engineering of the University of Zilina, in the field of security sciences in the past, we focused on security and resilience of transport systems, later added crisis management, followed by protection of persons and property and fire engineering. Today, the faculty is the most widely conceived research and educational institution in the Slovak Republic in the field of security research. In the field of security management, it cooperates mainly with Academy of the Police Force in Bratislava, Police of the Slovak Republic, city and municipal police, private security services and public administration.

The process of criminological forecasting depends on a lot of input data and is influenced by a wide range of circumstances. Criminology research is always multi-disciplinary and its results are important for establishing effective and efficient measures. Both branches of prediction methods have several limitations. In the branch of qualitative methods, the basic limitation is the lack of experts who would be able to make their knowledge available in real-time based on scientific research and thus define the future level of crime compared to the current state and the previous period. Normative methods, ideally based on typical scenarios, appear to be a real and effective tool. Within typological scenarios, it is possible to test individual types of measures and the result should be the optimal use of funds, forces and resources.

The second branch is quantitative research, which is based on real available data and information in information systems. It is based on research on time trends or econometric methods. By inserting the appropriate function, we obtain a trend curve, which most likely shows us the future development of crime. The results shortly are usually very close to reality, and the distant future can be influenced by some objective and sub-active factors.

From a methodological point of view, it seems appropriate to link qualitative and quantitative methods. By comparing the results of both types of methods, we can reach future results that will be very close to reality.

Conclusion

Predicting the level of crime in the selected region is an important basis for the effective and targeted implementation of security measures to reduce the level of crime in the region. Within quantitative prediction methods that predict the future based on statistical data, we can apply the extrapolation method using time trends. However, this method also brings with it some shortcomings that need to be compensated in some way. This opens up space for the application of qualitative prediction methods such as the wheels of the future, prediction scenarios or a panel of experts, which are based primarily on extensive theoretical and many years of practical experience of selected experts.

In the long run, we can see a decline in 'the overall level of crime in the Slovak Republic. This situation may be caused by the improvement and optimization of the actions of the police and security forces, as well as the introduction of new security measures in practice. However, today's rapidly evolving society is opening the door to new, more sophisticated crime, which can have a significant impact on future crime levels.

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